

# Motor Vehicle and Equipment Manufacturing

(SIC 371)

## SIGNIFICANT POINTS

- Nearly one-third of all the industry's jobs are located in Michigan.
- Very large establishments dominate the industry.
- Average earnings are very high compared to other industries.
- Employment is expected to decline and is highly sensitive to cyclical swings in the economy.

### Nature of the Industry

The motor vehicle is an intricate series of systems, subsystems, and components integrated into a final product. In the process of product design, no system is developed to exist as a separate entity; all systems must interface with others. Motor vehicle and equipment manufacturers, like the systems making up their products, are complex organizations that are constantly evolving to maximize efficiency and remain viable in a highly competitive market.

Motor vehicles play a central role in our society. Most Americans rely on them every day to get to work or school, to go shopping, or to visit family and friends. Businesses depend on motor vehicles to transport people and goods. The United States is the world's largest marketplace for motor vehicles due to the size and affluence of its population. In 1998, over 180 million motor vehicles—over 103 million passenger cars and 77 million trucks—were registered in the United States. The number of light trucks has shown especially steady growth since the mid- to late 1980's.

The motor vehicle and equipment manufacturing industry in the United States has become increasingly integrated into the international economy. American motor vehicle and equipment manufacturers have teamed up with some of their foreign competitors to design, produce, and distribute vehicles and parts, leading to a highly complex system of production. In a move to reduce distribution costs, manufacturers from the United States, Europe, and the Pacific Rim have located production plants in the countries where they plan to sell their vehicles. Foreign motor vehicle and parts makers with production sites in the United States are known as "transplants" and account for a growing share of production and employment in the United States.

Globalization of the industry has boosted competition among U.S. motor vehicle manufacturers, prompting innovations in product design and the manufacturing process. One result of these innovations is a proliferation of rapidly designed and produced new models aimed at niches in the market. Firms must be flexible to quickly implement new types of production. As the nature of the vehicle market in the United States continues to change, production techniques used by U.S. motor vehicle producers change along with it.

The cars we drive are only a small part of the story in motor vehicle and equipment manufacturing. In 1997, about 5,300 establishments manufactured motor vehicles and equipment, ranging from small parts plants with only a few workers to huge assembly plants that employ thousands.

Table 1 shows that nearly 7 out of 10 establishments manufactured motor vehicle parts and accessories—including axles, brakes, camshafts, defrosters, engines, frames, manifolds, radiators, steering mechanisms, transmissions, and windshield wiper systems. Other establishments specialized in assembling finished motor vehicles—passenger cars, sport utility vehicles, pickup trucks and vans, heavy-duty trucks, buses, and special purpose motor vehicles ranging from limousines to garbage trucks. Still others manufacture truck trailers, motor homes, and special bodies placed on separately purchased truck or bus chassis.

Motor vehicle and equipment manufacturers have a major influence on other industries in the economy. They are major consumers of steel, rubber, plastics, glass, and other basic materials, thus creating jobs in industries that produce those materials. The production of motor vehicles also spurs employment growth in other industries, including motor vehicle dealerships, automotive repair shops, gasoline service stations, highway construction companies, and public transit companies.

**Table 1. Percent distribution of establishments in motor vehicle and equipment manufacturing by activity, 1997**

Manufacturing activity	Establishments
Total .....	100.0
Motor vehicle parts and accessories .....	68.5
Truck and bus bodies .....	13.3
Motor vehicles and car bodies .....	9.1
Truck trailers .....	7.4
Motor homes .....	1.7

SOURCE: U.S. Department of Commerce, *County Business Patterns*, 1997

### Working Conditions

In 1998, 37 percent of workers in the motor vehicle and equipment manufacturing industry worked, on average, more than 40 hours per week. Overtime is especially common during periods of peak demand. Most employees, however, typically work an 8-hour shift; either from 7:00 a.m. to 3:30 p.m. or 4:00 p.m. to 12:30 a.m., with two breaks per shift and a half-hour for meals. A third shift often is reserved for maintenance and cleanup.

Although working conditions have improved in recent years, some production workers are still subject to uncomfortable conditions. Heat, fumes, noise, and repetition are not

uncommon in this industry. In addition, many workers come into contact with oil and grease and may have to lift and fit heavy objects. Employees also may operate powerful, high-speed machines that can be dangerous. Accidents and injuries usually are avoided when protective equipment and clothing are worn and safety practices are observed.

Newer plants are more automated and have safer, more comfortable conditions. For example, these plants may have ergonomic work areas, designed to accommodate the worker's physical size and eliminate unnecessary reaching and bending. Workers may function as part of a team, doing more than one job and thus reducing the repetitiveness of assembly line work.

Workers in the motor vehicle and equipment manufacturing industry experience higher rates of injury and illness than workers in most other industries. In 1997, cases of work-related injury and illness averaged 19.2 per 100 full-time workers in motor vehicle and equipment manufacturing, compared to 10.3 in all manufacturing industries and 7.1 in the entire private sector.

As in other industries, professional and managerial workers normally have clean, comfortable offices, and are not subject to the hazards of assembly line work. Improved ergonomics help clerical support workers avoid repetitive strain injuries, but employees using computer terminals for long periods may develop eye strain and fatigue.

## Employment

Motor vehicle and equipment manufacturing was among the largest of the manufacturing industries in 1998, providing 990,000 jobs. The majority of jobs, 60 percent, are in firms that make motor vehicle parts and accessories. About 29 percent of workers in the industry are employed in firms assembling motor vehicles and car bodies, while 11 percent work in firms producing truck and bus bodies, truck trailers, and motor homes.

Although motor vehicle and equipment manufacturing jobs are scattered throughout the Nation, certain States account for

the greatest number of jobs. Michigan, for example, accounts for nearly one-third of all jobs. Combined, Michigan, Ohio, and Indiana include over half of all the jobs in this industry. Other States that account for significant numbers of jobs are California, New York, Illinois, Missouri, North Carolina, Tennessee, and Wisconsin.

Employment is concentrated in a relatively small number of very large establishments. Over 51 percent of motor vehicle and equipment manufacturing jobs are in firms with over 1,000 workers (chart). Motor vehicle and car body manufacturing employment in particular is concentrated in large firms, whereas many motor vehicle parts and accessories jobs are found in small and medium-sized firms.

Compared to other industries, workers in motor vehicle and equipment manufacturing are somewhat older than average. In 1998, the median age was 40.8 years, compared to 39.1 years for all workers.

## Occupations in the Industry

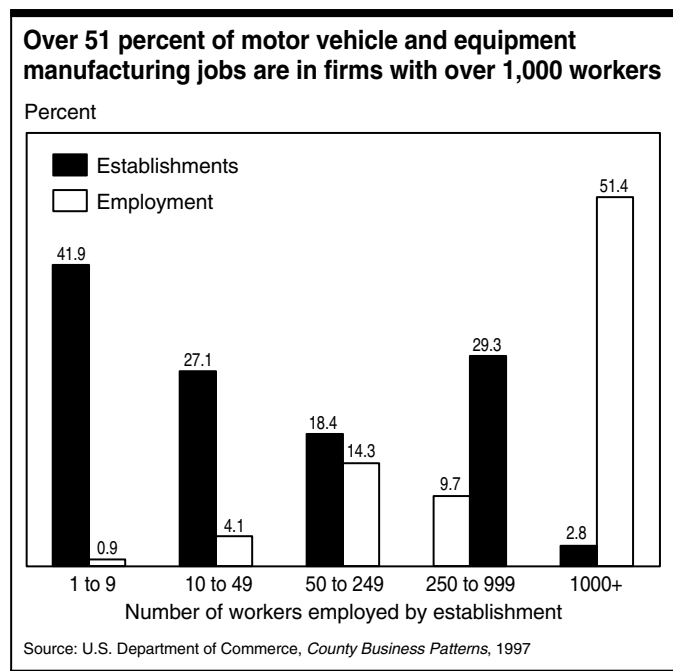
Most people know about the assembly line, a concept that originated in the motor vehicle manufacturing industry, but few are aware that production of a part or assembly of a motor vehicle is preceded by extensive design work, engineering, testing, and production planning. These tasks often require years and millions of dollars.

*Executives and managers* establish guidelines to follow in the design of motor vehicles by teams of experts in engineering, design, marketing, sales, finance, and production. From the earliest stages of planning and design, these specialists help assess whether the vehicle will satisfy consumer demand, meet safety and environmental regulations, and prove economically practical to make.

Using artistic talent, computers, and information on product use, marketing, materials, and production methods, *designers* create a design they hope will make the vehicle competitive in the marketplace. Sketches and computer-aided design techniques are used to create computer models of proposed vehicles. Workers may repeatedly modify and redesign the models until they meet the engineering, production, and marketing specifications. Designers working in parts and accessory production increasingly collaborate with manufacturers in the initial design stages to insure that motor vehicle parts and accessories are fully integrated into the design specifications for each vehicle.

Employing computer-aided drafting systems, *drafters* prepare drawings showing the technical specifications of motor vehicles and parts. Once the vehicle's design is established, a fiberglass model of the exterior and perhaps some interior features is made.

*Engineers*—the largest professional specialty occupation in the industry—play an integral role in all stages of motor vehicle manufacturing. They oversee the building and testing of the engine, transmission, brakes, suspension, and other mechanical and electrical components. Using computers and assorted models, instruments, and tools, engineers simulate various parts of the vehicle to determine whether they meet cost, safety, performance, and quality specifications. *Mechanical engineers* design improvements for engines, transmissions, and other working parts. *Electrical and electronics engineers* design the vehicle's electrical system, including the ignition system and accessories, and industrial robot control systems used to assemble the vehicle.



*Engineering technicians* are the largest technician occupation in the industry. They prepare specifications for materials, devise and run tests to ensure product quality, and study ways to improve manufacturing efficiency under the direction of engineers. For example, testing may reveal how metal parts perform under heat, cold, and stress, and whether emissions control equipment meets environmental standards. Finally, prototype vehicles incorporating all the components are built and tested on test tracks, road simulators, and in test chambers that can duplicate almost every driving condition, including crashes.

Before full production begins, engineers, technicians, scientists, designers, and others continue to modify the vehicle's interior and exterior design, and they determine the exact materials and parts to be used. *Industrial engineers* concentrate on plant layout, including the arrangement of assembly line stations, material moving equipment, work standards, and other production matters. *Computer programmers* write detailed instructions for computers, and *systems analysts* work with computer systems to improve manufacturing efficiency. When the many details are worked out, the machinery and tools required for assembly line production of the vehicle are set in place. *Purchasing agents and managers* buy the raw materials, machinery, tools, and other equipment required to produce the motor vehicles and parts.

*Industrial production managers* oversee *blue-collar worker supervisors*. These supervisors oversee skilled craft and repair workers, machine operators, and laborers, and coordinate all production activities—scheduling, staffing, equipment, quality control, and inventory control. A variety of manufacturing processes are used. For example, metal parts are welded; plastic and glass parts are molded and cut; seat cushions are sewn; and many parts are painted. Many manufacturing processes are highly automated; robots, computers, and programmable devices are an integral part of motor vehicle manufacturing. Throughout the manufacturing process, “statistical process control” (team work and quality control) is emphasized. From initial planning and design to final assembly, numerous tests and inspections insure that vehicles meet quality and safety standards.

*Production workers and operators, fabricators, and laborers* account for nearly 3 out of 4 motor vehicle and equipment manufacturing jobs (table 2). Formal educational requirements range from less than high school for unskilled laborers, to a high school diploma for semiskilled machine operators and skilled workers, to vocational school or community college training for some skilled jobs such as welders and cutters or mechanics and repairers. As the industry becomes more complex and the need for unskilled laborers decreases, employers are increasingly looking for candidates with at least a high school education.

*Operators, fabricators, and laborers* comprise over half of industry employment. These workers need physical stamina and coordination, and they must adapt to technological advances. *Assemblers* put together various parts to form subassemblies and then put the subassemblies together to build a complete motor vehicle. Some may perform other routine tasks such as mounting and inflating tires, adjusting brakes, and adding gas, oil, brake fluid, and coolant. *Grinders* and *polishers* work on metal, plastic, and glass parts. Although robots perform most of the welding, *welders* and *cutters* still are needed for some welding and for maintenance and repair duties.

**Table 2. Wage and salary employment in motor vehicle and equipment manufacturing by occupation, 1998 and projected change, 1998-2008**

(Employment in thousands)

Occupation	1998		1998-2008 Percent change
	Number	Percent	
<b>All occupations</b> .....	990	100.0	-5.0
<b>Operators, fabricators, and laborers</b> .....	523	52.8	-4.9
Hand workers, including assemblers and fabricators .....	289	29.2	-4.9
Machine setters, operators, and tenders .....	183	18.5	-3.7
Helpers, laborers, and material movers, hand .....	31	3.2	-8.7
Transportation and material moving machine and vehicle operators ...	20	2.0	-10.6
<b>Precision production, craft, and repair</b> .....	203	20.5	-8.9
Mechanics, installers, and repairers ..	52	5.3	-5.8
Blue-collar worker supervisors .....	36	3.6	-13.9
Metal workers, precision .....	29	2.9	-6.4
Inspectors, testers, and graders .....	29	2.9	-17.1
Assemblers, precision .....	24	2.5	-7.3
Electricians .....	15	1.5	-4.4
Tool and die makers .....	13	1.3	-13.9
<b>Professional specialty</b> .....	93	9.4	8.5
Engineers .....	68	6.8	10.2
<b>Executive, administrative, and managerial</b> .....	67	6.7	-3.8
Management support occupations ....	26	2.6	-5.2
Industrial production managers .....	10	1.1	2.2
<b>Administrative support, including clerical</b> .....	56	5.7	-12.3
Material recording, scheduling, dispatching, and distributing occupations .....	25	2.6	-11.3
<b>Technicians and related support</b> .....	24	2.4	-9.0
Engineering technicians .....	22	2.2	-8.4
<b>Marketing and sales</b> .....	12	1.3	-4.4
<b>Service</b> .....	11	1.2	-4.4

*Machine setters, operators, and tenders*—who run various machines that produce the array of motor vehicle bodies and parts—account for nearly 1 out of 5 jobs. These workers set up and operate machines and make adjustments according to their instructions. In computer-controlled systems, they monitor computers that control the machine processes and may have little interaction with the machinery or materials. *Machine tool cutting and forming setters, operators, and tenders*, the largest occupation in this group, operate numerous machines from drill presses used to drill holes to lathe machines that cut materials such as rods or crankshafts. Some workers specialize in one type of machine; others operate more than one type.

Among other machine operators, *numerical-control machine-tool operators* use machine tools that can be programmed to manufacture parts of different dimensions automatically. *Welding machine operators* tend laser-beam and other welding machines that join together metal parts. *Painting and coating machine operators* paint surfaces of motor vehicles, and *furnace operators* tend heating equipment that

performs such operations as baking fiberglass, drying painted products, and fusing glass or enamel to metal products. *Sewing machine operators* sew together pieces of material to form seat covers and other parts.

Keeping the plant running smoothly requires vehicle and mobile equipment operators and manual laborers. *Industrial truck and tractor operators* carry materials and equipment around and between factories, warehouses, and outdoor storage areas. *Truckdrivers* carry raw materials to plants, equipment and materials between plants, and finished motor vehicles to dealerships for sale to consumers. Among unskilled laborers, *freight, stock, and material movers* move materials to and from storage areas, loading docks, delivery vehicles, and containers. *Machine feeders* and *offbearers* feed materials into or remove materials from machines or equipment on the assembly line, and *hand packers* manually package or wrap materials. *Vehicle washers* and *equipment cleaners* clean vehicles and machinery using various cleaning equipment and agents.

*Precision production, craft, and repair workers*, the second largest group of production jobs, account for 1 out of 5 jobs in the motor vehicle and equipment manufacturing industry. These skilled workers set up, maintain, and repair equipment and assemble complex components, such as engines. *Electricians* service complex electrical equipment. *Plumbers* and *pipefitters* install and repair piping, valves, pumps, and compressors. *Industrial machinery mechanics* and *maintenance repairers* maintain machinery and equipment to prevent costly breakdowns and, when necessary, perform repairs. *Millwrights* install and move machinery and heavy equipment according to the factory's layout plans. *Vehicle and mobile equipment mechanics* repair bodies, engines, and other parts of motor vehicles, industrial trucks, and other mobile heavy equipment.

*Precision assemblers* assemble engines and perform other assembly work requiring great precision. Throughout the manufacturing process, *inspectors, testers, and graders* ensure that motor vehicles and parts meet quality standards. They inspect raw materials, check parts for defects, check the uniformity of subassemblies, and test drive vehicles. *Machinists* produce precision metal parts that are made in numbers too small to produce with automated machinery. *Tool and die makers* produce tools, dies, and special guiding and holding devices used in machines. *Sheet metal workers* cut, bend, and straighten sheet metal suitable for various motor vehicle parts.

### Training and Advancement

Faced with technological advances and the continued need to cut costs, manufacturers increasingly emphasize continuing education and cross-train many workers, that is, they train workers to do more than one job. This has led to a change in the profile of the industry's workers. Standards for new hires are much higher now than in the past. Employers increasingly require a minimum of a high school diploma as the number of unskilled jobs declines. The average worker is expected to work with much less supervision than in the past and needs to be self-motivated. Because many plants now emphasize the team approach, employees interact more with co-workers and superiors to determine the best way to get

the job done. Therefore, employers look for employees with good communication and math skills, as well as an aptitude for computers, problem solving and critical thinking. However, manual dexterity will continue to be necessary in many production jobs.

Opportunities for training and advancement vary considerably by occupation, plant size, and sector. Training programs in larger auto and light truck assembly plants usually are more extensive than those in smaller parts and accessories, truck trailer, and motor home factories. Production workers receive most of their training on the job or through more formal apprenticeship programs. Training normally takes from a few days to several months and may combine classroom with on-the-job training under the guidance of more experienced workers. Attaining the highest level of skill in some production jobs requires several years, however. Training includes courses in health and safety, teamwork, and quality control. With advanced training and experience, production workers can advance to inspector or more skilled production, craft, or repair jobs.

Skilled precision production workers—such as tool and die makers, millwrights, machinists, pipefitters, and electricians—are normally hired on the basis of previous experience and, in some cases, a competitive examination. Alternatively, the company may train inexperienced workers in apprenticeship programs that last up to 5 years and combine on-the-job training with classroom instruction. Typical courses include mechanical drawing, tool designing and programming, blueprint reading, shop mathematics, hydraulics, and electronics. Training also includes courses on health and safety, teamwork, quality control, computers, and diagnostic equipment. The most highly motivated, experienced workers can advance to blue-collar worker supervisor.

Motor vehicle manufacturers provide training opportunities to all workers, regardless of educational background. Manufacturers offer classes themselves and pay tuition for workers who enroll in colleges, trade schools, or technical institutes. Workers sometimes can get college credit for training received on the job. Company training ranges from courses in communication skills to computer science. Formal educational opportunities range from courses in English and basic mathematics to work-study programs leading to college and graduate degrees in engineering, management, and other fields.

### Earnings

Average weekly earnings of production or non-supervisory workers in the motor vehicle and equipment manufacturing industry are relatively high. In 1998, workers in the industry earned \$780 per week, compared to \$563 for all manufacturing industries, and \$442 for the entire private sector. At \$933 per week, earnings of production workers in establishments that manufacture complete motor vehicles and car bodies were among the highest in the Nation. Workers in establishments that make motor vehicle parts and accessories averaged \$732 weekly; those in truck and bus body manufacturing earned \$681; while truck trailer manufacturing workers earned \$481. Earnings in selected occupations in motor vehicle and equipment manufacturing appear in table 3.

**Table 3. Median hourly earnings of the largest occupations in motor vehicle and equipment manufacturing, 1997**

Occupation	Motor vehicle manufacturing	All industries
Industrial engineers, except safety .....	\$28.33	\$24.18
Electricians .....	21.45	16.54
Tool and die makers .....	20.87	17.37
First line supervisors and managers/ supervisors-production and operating workers .....	20.13	16.62
Machinery maintenance mechanics .....	19.81	14.72
Machine tool cutting operators and tenders, metal and plastic .....	18.87	11.32
Production inspectors, testers, graders, sorters, samplers, and weighers .....	17.83	10.15
Machine builders and other precision machine assemblers .....	16.56	13.47
Assemblers and fabricators, except machine, electrical, electronic, and precision .....	14.10	9.25
Welders and cutters .....	11.88	11.90

These hourly earnings may increase during overtime or special shifts. Workers generally are paid 1 1/2 times their normal wage rate for working more than 8 hours a day, 40 hours a week, or for working on Saturdays. They may receive double their normal wage rate for working on Sundays and holidays. The largest manufacturers and suppliers often offer other benefits including paid vacations and holidays; life, accident, and health insurance; education allowances; non-wage cash payment plans, such as performance and profit-sharing bonuses; and pension plans. Some laid-off workers in the motor vehicle and equipment manufacturing industry have access to supplemental unemployment benefits, which can provide them with nearly full pay and benefits for up to 3 years, depending on the worker's seniority.

In 1998, 36.9 percent of workers in motor vehicle and equipment production were union members or were covered by union contracts, compared to 15.4 percent of workers throughout private industry. Unionization rates are higher in motor vehicle production than in parts and accessories producers. The primary union in the industry is the United Automobile, Aerospace, and Agricultural Implement Workers of America, also known as the United Auto Workers (UAW). Nearly all production workers in motor vehicle assembly plants and most in motor vehicle parts plants are covered by collective bargaining agreements negotiated by the UAW. Other unions—including the International Association of Machinists and Aerospace Workers of America, the United Steelworkers of America, and the International Brotherhood of Electrical Workers—cover certain plant locations or specified trades in the industry.

## Outlook

Employment in the motor vehicle and equipment manufacturing industry is expected to decline 5 percent over the 1998-2008 period. The need to replace workers who transfer to jobs in other industries or retire will be the only source of job openings. However, a substantial number of job openings is

expected from this source because over one-third of the motor vehicle manufacturing workforce is over 44 years old and positioned to retire in the near future.

Not all the workers who transfer to other occupations or retire will be replaced. Jobs will be lost due to downsizing and productivity increases. The growing intensity of international and domestic competition has increased cost pressures on manufacturers. In response, they have sought to improve productivity and quality through the application of high technology production techniques, including robots, computers, programmable equipment, and other production techniques. Increasing productivity should more than offset the increasing demand for motor vehicles, resulting in a net loss of jobs. In fact, output in the motor vehicle and equipment manufacturing industry is projected to increase, while employment is expected to decline.

Growth in demand for motor vehicles could be limited by a number of factors. A slowdown in the growth of the driving age population, as the smaller post-baby-boom generation comes of age may slow growth in demand for cars and trucks. Competition from foreign motor vehicle and parts producers will continue to control much of the U.S. market. Other factors that may limit growth of domestic motor vehicle production include improvements in vehicle quality and durability, which extend longevity and more stringent safety and environmental regulations, which increase the cost of producing and operating motor vehicles.

Employment in motor vehicle and equipment manufacturing is highly sensitive to cyclical swings in the economy. Over the 1972-98 period, employment peaked at over 1 million in 1978 and plunged to under 700,000 in 1982, a recession year. A 10-percent change in employment from one year to the next is not unusual, and employment has changed as much as 20 percent in one year (chart). During periods of economic prosperity, consumers are more willing and able to purchase expensive goods such as motor vehicles, which may require large down payments and extended loan payments. During recessions, however, consumers are more likely to delay such purchases. Motor vehicle manufacturers respond to these changes in demand by hiring or laying off workers. As it has become more critical to adopt cost-saving measures, the industry is increasingly turning to contract employees because it is less costly to hire and lay off such workers, and it serves as a screening mechanism as jobs become more complex.

Overall industry employment is expected to decline by 50,000 jobs over the 1998-2008 period. Expanding factory automation, robotics, efficiency gains, and the need to cut costs is driving the downward trend. The movement towards efficiency and automation will force an employment decline in hand worker, precision assembler, and machine setter occupations. Employment of service workers, such as custodians, is expected to continue its decline as firms employ service contractors to perform these duties. Administrative support and clerical workers will absorb some of the decline in industry employment, losing 7,000 jobs to expanding office and warehouse automation. Employment in marketing and sales is also expected to decline.

Automation and continued global competition, however, are expected to produce growth for engineers, industrial production managers, and computer specialists. These workers will increasingly be relied upon for further innovation in reducing costs and enhancing competitive advantage.

### Employment in motor vehicle and equipment manufacturing is highly sensitive to cyclical swings in the economy



#### Sources of Additional Information

Information on employment and training opportunities in the motor vehicle and equipment manufacturing industry is available from local offices of the State employment service, employment offices of motor vehicle and equipment

manufacturing firms, and locals of the unions mentioned above.

Detailed information on most occupations in this industry, including the following, appears in the 2000-01 *Occupational Outlook Handbook*.

- Blue-collar worker supervisors
- Designers
- Drafters
- Electricians
- Engineers
- Engineering technicians
- Handlers, equipment cleaners, helpers, and laborers
- Industrial machinery repairers
- Industrial production managers
- Inspectors, testers, and graders
- Machinists and numerical tool and process control programmers
- Maintenance mechanics, general utility
- Material moving equipment operators
- Material recording, scheduling, dispatching, and distributing occupations
- Mechanical engineers
- Metalworking and plastics-working machine operators
- Millwrights
- Painting and coating machine operators
- Precision assemblers
- Tool and die makers
- Welders, cutters, and welding machine operators